

- How Data Quality and Accuracy Standards Are Met - The computer applications that process data, include data entry edit routines and batch edits to ensure the data in the systems meet defined data quality and accuracy standards.

## 8. Planning

The Department uses the following primary planning documents: the budget documents; the Department's strategic plan; the performance partnership agreement and performance partnership grant work plans with EPA; the work plans associated with other federal grants and cooperative agreements; the annual work plans between the programs and the regional offices; and the quality assurance project plans and associated work plans.

When an environmental data or other natural resource data need has been identified, appropriate technical and quality assurance staffs begin the planning process and development of a quality assurance project plan. The Department uses the data quality objectives process to ensure that the resulting data will meet agency needs. The Department also has ongoing environmental data and other natural resource data operations for which the data needs are relatively constant from year to year. The quality assurance project plans or associated work plans for these data operations are reviewed and updated on an annual basis to meet the needs of the user of the environmental data and other natural resource data.

## 9. Implementation of Work Processes

Ultimately, the Department's management team is responsible for ensuring that the work is performed in accordance with appropriate planning documents. This quality management plan provides the framework for defining the procedures to ensure that environmental data and other natural resource data operations are implemented in accordance with an approved quality assurance project plan. The specific quality management roles and their associated responsibilities are described in Section 1.5 above.

Each year, the QA manager and the QA coordinators will review this quality management plan for needed changes. Every five years, the QA manager and the QA coordinators will perform a complete review of this quality management plan, make any needed changes, and initiate an approval process within the Department and the EPA.

The Department's management team and EPA representatives discuss the development and maintenance of state quality assurance programs during the performance partnership agreement process.

## 10. Assessments and Evaluations

### *Internal Review of Documentation*

Supervisors overseeing the work of field staff, review documentation of field activities to ensure quality. They engage with field staff to resolve any documentation issues and approve documentation that meets the Department's policies, processes, guidance, and procedures.

### *Data Quality Assessments*

A QA coordinator or other staff with appropriate expertise assesses the quality of data before it is used to make decisions, in order to ensure that it is satisfying the quality assurance requirements specified in the quality assurance project plan. The Department conducts data quality assessments according to EPA documents titled Data Quality Assessment: A Reviewer's Guide and Data Quality Assessment: Statistical Methods for Practitioners.

### *Quality System Audits and Management Systems Reviews*

As stated in Section 2.6 of this Quality Management Plan, QA coordinators are responsible for conducting internal audits, management systems reviews, and technical system audits in their respective programs and reporting findings to the QA manager. This function may be limited by staff training and capacity, and may as an alternative rely on EPA oversight through audits. Each is a qualitative evaluation of a data collection operation and the Department's quality management structure, policies, practices, processes, and procedures to determine if these elements are adequate to ensure that the Department's data collection effort will yield the needed type and quality of data. These reviews are used to determine the effectiveness of, and adherence to, the quality system and the adequacy of resources and personnel provided to achieve and ensure quality.

The management systems reviews will be conducted by a review team with a minimum of two members according to the most current version of Guidance on Assessing Quality Systems (EPA QA-G3) for Preparing, Conducting, and Reporting the Results of Management Systems. Reviews of programs will include a random sampling of the projects for that program (a list of the projects will be requested from the program as part of the management systems review) to determine if the projects were correctly identified as including environmental data generation and use and if the quality assurance requirements, including approved quality assurance project plans prior to environmental data generation and use, were applied and adequately addressed. The management systems reviews will consist of meetings with the management of the Department reviewed program, interviews with personnel, and file reviews.

Results of the management systems review will be reported to management through a Draft Findings Report. The reviewed program will be given the opportunity to respond to the Draft Findings Report and to develop a Corrective Action Plan to address any issues identified as requiring corrective action. The Corrective Action Plan must identify the corrective action, responsible staff, and the projected completion date for each finding requiring corrective action. The QA manager will review the Corrective

Action Plan and prepare any necessary responses for discussion with the management of the reviewed organization or program.

Once any outstanding issues have been addressed and the corrective actions and schedule agreed upon by the QA manager and the reviewed program's management, a Final Report will be issued. The confirmation and implementation of the corrective actions will be done through the submittal of associated documents (e.g., a revised quality assurance project plan) to the QA manager for review or through a follow-up evaluation.

#### *Management Independent Audits*

The EPA conducts annual audits and the Inspector General's Office conducts periodic audits of the state's environmental programs. These audits normally include some type of review of the program's quality management system. The Department takes action that is needed to address the comments and recommendations from these audits. The QA manager responds to the EPA regarding the actions that are taken.

#### *Technical System Audits*

The Department conducts technical systems audits as thorough, systematic, on-site, qualitative evaluations of facilities, equipment, personnel, training, procedures, SOPs, recordkeeping, data validation, data management, and reporting aspects of field and laboratory activities. Technical systems audits typically include field audits of staff who conduct natural resource sampling activities. Auditors can stop field activities or take other actions to ensure the collection of quality information. The Department takes action to address audit findings. The Department conducts these audits based on an EPA document titled *Guidance on Technical Audits and Related Assessments for Environmental Data Operations*.

A technical systems audit can be conducted with the assistance from EPA Region VII, as requested. The responsibility for and the frequency of technical systems audits are specified in quality assurance project plans. The requirement for a technical systems audit should be described in a project specific or generic quality assurance project plan. A technical systems audit will result in completion of an assessment report in a timely manner including appropriate levels of review and approval as well as how and when corrective actions are to be taken in response to the findings.

Assessment and response action for analytical data quality are outlined in the standard operating procedure 2090: "Quality Control Procedures and Quality Control Charts," and will be conducted by the supervisor of the analytical laboratory in the Environmental Services Program.

#### *External Reviews and Performance Audits*

External parties, such as the EPA, occasionally conduct management systems reviews and performance audits on the Department's quality system to assess its effectiveness. The Department uses the results of these reviews and audits to revise the quality management plan, as appropriate.



#### *Technical Independent Audits*

The Department participates in the annual EPA Performance Audit Sample Program–Water Supply Series. The Department reviews data resulting from participation in this program for accuracy and takes action to address identified issues.

The EPA conducts tri-annual on-site laboratory audits to assess the laboratory procedures in order to maintain the Department's certification under the requirements of the Safe Drinking Water Act. The Department takes action to address audit findings.

The EPA, at the Department's request, conducts quality assurance oversight and quality control oversight of field inspection activities, including sample collection. The EPA reports its findings and the Department takes action to address these findings.

QA coordinators periodically audit staff that review and approve project plans prepared by external parties. Each QA coordinator informs the QA manager of their plans prior to conducting these audits and provides a report of the results after the audits are completed. The QA coordinators discuss the audit results with staff, the program director, and the QA manager. If any changes are required, staffs are informed of the necessary corrective actions that must be implemented in order for staff to remain a designee for reviewing and approving external quality assurance project plans.

### **11. Quality Improvement**

The QA manager has the overall responsibility for identifying, planning, implementing, and evaluating the effectiveness of quality improvement activities and ensuring that corrective actions are taken to address quality system issues related to environmental data and other natural resource data operations. The project officers identified for each quality assurance project plan, field personnel, and laboratory personnel are responsible for identifying and recommending appropriate actions to correct any quality assurance deficiencies. Periodic coordination meetings are held to address issues related to specific quality assurance project plans and to recommend any necessary corrective actions.

EPA Region VII, in the performance of their responsibilities to conduct annual evaluations of the state's environmental programs and laboratories, also identifies any quality assurance deficiencies. Corrective actions can then be taken to maintain and improve the effectiveness of the quality system.

### **12. Reference Documents**

Data Quality Assessment: A Reviewer's Guide (EPA QA/G-9R), February 2006

EPA Requirements for Quality Management Plans (EPA QA/R-2), March 2001, (reissued May 2006)

EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5), March 2001, (reissued May 2006)

Guidance for Developing Quality Systems for Environmental Programs (EPA QA/G-1), November 2002, (reissued January 2008)

Guidance for Geospatial Data Quality Assurance Project Plans (EPA QA/G-5G), March 2003

Guidance on Assessing Quality Systems (EPA QA/G-3), March 2003

Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4), February 2006

Guidance on Quality Assurance Project Plans (EPA QA/G-5), December 2002

Guidance on Choosing a Sampling Design for Environmental Data Collection (EPA QA/G-5S), December 2002

Guidance on Quality Assurance Project Plans for Modeling (EPA QA/G-5M), December 2002

Guidance for Preparing Standard Operating Procedures (SOPs) (EPA QA/G-6), April 2007

Guidance on Technical Audits and Related Assessments for Environmental Data Operations (EPA QA/G-7), January 2000, (reissued May 2006)

Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8), November 2002, (reissued January 2008)

Data Quality Assessment: A Reviewer's Guide (EPA QA/G-9R), February 2006

Data Quality Assessment: Statistical Tools for Practitioners (EPA QA/G-9S), February 2006

Guidance for Developing a Training Program for Quality Systems (EPA QA/G-10), December 2000, (reissued May 2006)

Guidance on Quality Assurance for Environmental Technology Design, Construction and Operation (QA/G-11), January 2005

Overview of the EPA Quality System for Environmental Data and Technology (EPA/240/R-02/003), November 2002

Quality Management Plan for Region7, July 2006



**Missouri Department of Natural Resources**

**Missouri Geological Survey**

**Geological Survey Program**

***Guidance for Conducting a Detailed Hydrogeologic Site  
Characterization and Designing a Groundwater Monitoring Program***

December 10, 2010 – revised March 2016

DRAFT



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## 1.0 - Introduction

This guidance is intended to shed light on the elements required to design an adequate groundwater monitoring program. The adequacy of a groundwater monitoring program depends greatly on the quality of the detailed hydrogeologic site characterization used to design the program. Regardless of regulatory agency oversight, the basic requirements to characterize the hydrology and geology underlying a specific site are the same. Only after an adequate understanding of the underlying geology and hydrology has been achieved can the implementation of a groundwater monitoring program begin.

## 2.0 - Definitions

**Aquifer** – A hydrostratigraphic unit or group of units which are capable of providing sufficient amounts of water to meet intended purposes.

**Detailed site characterization** – A scientific examination of a facility that allows the identification and characterization of the hydrostratigraphic units underlying a facility, including the uppermost continuous zone of saturation. Typically, this includes a three-dimensional assessment of the underlying geologic materials and the movement of groundwater within the materials.

**Facility** – An area and/or locations that may be impacted by contaminants. This includes liquid and solid waste treatment facilities as well as associated land application areas.

**Groundwater monitoring program** – A program utilizing the site specific data collected during a detailed site characterization to establish a system of monitoring wells that will best detect any release of contaminants into the environment.

**Groundwater monitoring plan** – A plan (typically a document) that describes not only the groundwater monitoring program, but also the strategy for effectively monitoring groundwater at the facility. The plan typically details the standard operation procedures related to field sampling, laboratory analysis, data presentation and analysis of data trends.

**Hydrostratigraphic unit** – A geologic stratum or group of strata that exhibit similar characteristics with the respect to transmission or fluids or gasses.

**Lysimeter** – An apparatus that collects water moving through the soil column and used to determine the water soluble constituents or contaminants transported vertically within the unconsolidated materials.

**Monitoring well** – A well that is ten feet (10') or greater in depth, screened or open to a saturated interval for the specific purpose of obtaining site-specific water quality,

contaminant movement or hydrogeologic data. Soil borings, piezometers, and some lysimeters are considered types of monitoring wells or monitoring devices.

**Piezometer** – A type of monitoring well that is ten feet (10') or greater in depth and used to measure the hydraulic head of groundwater in a subsurface water bearing zone and/or conduct hydrologic testing of a hydrostratigraphic unit.

**Uppermost continuous zone of saturation** – The hydrostratigraphic zone nearest the natural ground surface which is capable of yielding sufficient amounts of water to allow sampling

### **3.0 - Elements of a Detailed Site Characterization Work Plan**

- Topographic map at a scale of 1:24,000
- Site map at suitable scale to display pits, borings and piezometers
- General description of proposed facility
- Total acreage of facility including individual land application areas
- Description of proposed methods for site exploration to include:
  - Drilling methods
  - Sampling procedures
  - Piezometer and monitoring well construction methods
  - Approximate screen depths
  - Specific grout mixtures and emplacement methods
  - Aquifer test methods (if required)
  - Record keeping procedures for:
    - Well logs, boring logs, drilling logs, and pit logs
  - On-site precipitation data (If required)

### **4.0 - Elements of a Detailed Site Characterization**

Almost all groundwater investigations will include an intrusive field program that involves drilling, hydrological monitoring, and groundwater sampling. The extents of such investigations are a function of the size and complexity of the facility. Depending on the geologic environment, several drilling techniques may be available. The U.S. E.P.A. documents 625/R-93/003a and 625/R-93/003b provide an overview of subsurface characterization and monitoring techniques which can be utilized.

#### **4.1 - General Procedures**

- As per the State of Missouri's RSMo 256.450 through 256.483, all geologic and hydrogeologic work must be completed by a registered geologist.
- A consultant who subcontracts the drilling of monitoring wells and/or piezometers must hold a restricted or non-restricted monitoring well installation contractors permit as required by Missouri Well Construction Rules, 10 CSR 23 chapters 1, 2 and 4.
- Drilling must be done by a driller holding a non-restricted monitoring well installation contractor permit. As required by Missouri Well Construction Rules, 10 CSR 23 chapters 1, 2 and 4.

#### **4.2 - Oversight Requirements**

- A qualified groundwater scientist should direct:
  - Excavation of all pits
  - Drilling of all borings
  - Performance of any geophysical surveys
  - Installation, development, and abandonment of all exploratory wells or piezometers
- A qualified groundwater scientist should supervise:
  - All field testing used to determine geologic or hydrologic characteristics of materials encountered
  - All field testing of materials intended for use at a proposed site
- A qualified groundwater scientist should maintain accurate and complete field notes of investigation activities.
- A land surveyor registered with the State of Missouri must determine the location and elevation of all wells and piezometers.
  - Borings, excavation pits, and transects as part of a geophysical exploration must be surveyed to within one-tenth (0.1) foot.
  - Monitoring well and piezometer measuring-point elevations must be accurate to the nearest one-hundredth (0.01) foot.

#### **4.3 - Field Investigation**

##### **4.3.1 - Surficial Materials Investigation**

- A qualified groundwater scientist should determine:

- The thickness of significant geologic units above competent bedrock
- The geotechnical characteristics of significant geologic units above competent bedrock
- All borings should be continuously sampled (exploration pits may be substituted for borings if the surficial materials thickness can be adequately and completely evaluated by the pits).

#### 4.3.2 - Bedrock and Hydrogeologic Characterization of Aquifer

- A qualified groundwater scientist must determine:
  - Depth of the uppermost aquifer(s) beneath the proposed site
  - Thickness of the uppermost aquifer(s) beneath the proposed site
  - Lateral extent of the uppermost aquifer(s) beneath the proposed site
  - Additional aquifers which are potentially at risk (as determined by GSP)
- Piezometer construction and development must be done in accordance with Missouri Well Construction Rules 10 CSR 23-4.
- Piezometers should be distributed in a grid pattern across the site or located in a manner that will optimize characterization of the site.
- An adequate number of piezometers must be located across the facility or anticipated facility to sufficiently characterize each aquifer
  - The location and spacing of necessary borings depends on subsurface complexity to the project. The density of boreholes should be greater when characterizing geology that is more complex. Table No. 1, located below, discusses the factors most commonly influencing borehole spacing.

<b>Table No. 1 - Factor Influencing the Density of Boreholes</b> (Modified from U.S. EPA, 1992)	
Factors that may substantiate reduced density of boreholes	Factors that may substantiate increased density of boreholes
<ul style="list-style-type: none"> <li>• Simple Geology (e.g., horizontal, thick homogeneous geologic strata that are continuous across a site and unfractured) substantiated by site specific geologic information</li> <li>• Use of electric cone penetrometer surveys with additional tools</li> <li>• Use of geophysical data to correlate hydrological data between boreholes</li> <li>• Use of surface to borehole and cross borehole geophysical methods to interpret complex subsurface geologic structures</li> </ul>	<ul style="list-style-type: none"> <li>• Fractured zones, conduits in karst terranes</li> <li>• Suspected pinch-out zones</li> <li>• Tilted or folded geologic formations</li> <li>• Suspected zones of high hydraulic conductivity that would not be defined by drilling at large horizontal intervals</li> <li>• Laterally transitional geologic units with irregular hydraulic conductivities</li> </ul>

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- In the event that the original series of piezometers fail to adequately characterize the hydrogeology of a site, especially in the case of complex geological settings, additional piezometers and site characterization may be warranted.
  - An example of complex geologic setting is karst terrane. The carbonate bedrock which produces this terrane underlies a large portion of Missouri. Groundwater flow is typically through discrete conduits with velocities varying by orders of magnitude.
- It is recommended that water level data be collected for a minimum of one year to allow for the assessment of seasonal variation within the uppermost continuous zone of saturation.
- The measuring point elevation of the piezometers must be determined by survey.
- If geophysical methods are used, piezometers must be installed to verify the results of the geophysical survey.
- Injected tracers are an additional and viable field method used to help characterize the hydrogeology of a facility, especially in karst terranes. A tracer typically consists of a dye carried by groundwater that will indicate the direction and movement of groundwater and/or potential contaminants across a site.
- It is recommended that a continuously recording precipitation gauge, capable of measuring precipitation events greater than one-tenth (0.1) inch, be installed at the site concurrent with or prior to installation of piezometers.
- It is recommended that the hydraulic conductivity be determined in one out of every four borings (25% of borings on site) for each geologic unit evaluated.
- The hydraulic conductivity should be determined in the field.
- Acceptable field tests are in-situ slug, pump, or packer tests which isolate the geologic unit of interest.

#### **4.4 - Records**

- Field logs and notes pertaining to the field investigation should be retained.
- At a minimum, a qualified groundwater scientist should, in the field, note the following on a descriptive log:
  - Texture of bedrock or surficial materials
  - Color (Qualitative description - including mottling) of bedrock or surficial materials

- Relative degree of saturation (description)
  - Voids
  - Geologic origin
  - Secondary permeability features
  - Zones of incomplete sample recovery
  - Depth at which water was encountered
  - Depth and rate of drilling fluid gain or loss
  - Type and size of drilling/excavation equipment
  - Drilling rate or blow counts
  - Packer test (including interval tested and results)
  - Start and Stop time for drilling/excavation
  - Names of field personnel
  - Date, time, weather conditions
  - Depth to water upon completion
- All boring or pits should be observed until water levels have stabilized or for at least 24 hours following completion.
  - Observations should determine if groundwater has entered the borehole, the depth to water, and if possible, the water bearing zones.
  - All borings and pits should be protected from rainfall and runoff during observation.

#### **4.5 - Water Level Data Collection**

- Measurements of water level should be made every month for one year for all piezometers.
- Water level measurements should be made to the nearest tenth (0.1) of a foot
- Water level measurements should be made within a time period of 48 hours if possible.

#### **4.6 - Monitoring Wells**

- Monitoring wells are not required as part of the detailed hydrogeologic site characterization, however water quality data will be required as part of the regulatory process. Typically, for small 1 to 5 acre sites, a minimum of one monitoring well must be located hydrologically up gradient and three monitoring wells located hydrologically down gradient. Larger facilities and land application areas will likely require additional monitoring wells and sampling locations.

## **5.0 - Presentation of Data and Interpretations**

A hydrogeologic site investigation report should provide a detailed description of the geology and hydrology underlying the facility. The description should be based on data collected from boreholes, piezometers and test pits. The report must be prepared under the direction of a qualified groundwater scientist who is a geologist registered in the State of Missouri per RSMo 256.450 through 256.483 and the rules promulgated pursuant thereto. This person must sign and seal the report.

The following information should be provided within the report.

### **5.1 - Table of Contents**

### **5.2 - Introduction (general information about study area)**

- Location:  
A written narrative of the geographic setting with legal description (Section, Township, and Range).
- Regional Geology:  
A written narrative describing the regional lithologic, stratigraphic, and hydrologic settings of the area.
- Historic Land Use:  
A written narrative describing previous land use such as mining or mineral exploration.

**5.3 - Method of Study** - A written narrative must be provided which describes field and laboratory procedures used to characterize geologic and hydrologic conditions of the site. Standardized laboratory and field procedures may be referenced. All other procedures must be described in detail.

**5.4 - Results of Investigation** - A written detailed narrative must be provided that describes the site-specific geology and hydrology based on data collected. The narrative must include explanations of any anomalous data. Interpretations of results must be presented in a clear and concise manner.

**5.5 - Conclusion** - A written narrative must be provided that details how the site-specific geology and hydrology will impact the facility and design of the groundwater monitoring program. The narrative must assess any inadequacies of the investigation and propose future investigations if needed. The narrative must describe the proposed groundwater monitoring program design.

**5.6 - References** - All published information sources used in the compilation or research of the hydrogeologic investigation must be listed.

**5.7 - Appendices** - The appendices of the site characterization report must include:

- Compiled logs of all borings, excavations, wells and piezometers.
- The raw data for any and all tests (e.g., pumping tests).
- All additional information that may facilitate the assessment of the acceptability of the proposed site.
- Logs - Lithologic logs of all borings and excavations, including well construction diagrams, should be provided. Each log should include borehole identification, borehole grid location, soil and rock description, sample depths, methods of sampling, sampling date, land surface elevation, borehole total depth.

**5.8 - Tables** - Presentation of tabular data that should be supplied include the following:

- All borehole, well and piezometer construction data. Such data should include the borehole, well or piezometer identification, grid location, total depth, surface elevation and, if applicable, screened interval and hydrogeologic unit monitored.
- Monthly groundwater elevation measurements for each piezometer or well. The table(s) should indicate the well or piezometer identification, depth to water from measuring-point, groundwater elevation and date of measurement.
- Results of all unconsolidated material testing. The table(s) should include the sample location, depth, sampling date, and test results.
- Results of all hydrologic testing. The table(s) should include the well or piezometer identification, method and date of test, depths of interval tested, hydrologic unit tested and results.
- Daily precipitation data collected at the site.

**5.9 - Maps -**

All detailed site maps for the report should be drawn on a scale where one inch equals 400 feet or less. As appropriate, maps should be drawn on a consistent scale. All maps must include a scale, north arrow, and a clear and concise legend describing all of the symbols used on the map. More than one map will be required to include the following information:

- A base map showing initial topography of the facility or proposed facility

- Maps(s) showing land use, ownership, residences, septic systems, lateral lines, buildings, wells, cisterns, mined or quarried areas, mine shafts, spoil piles, and all other man-made features within 1/4 mile of the facility or proposed facility.
- Map(s) showing springs, water courses, streams, lakes, caves, sinkholes, rock outcrops, and other significant geologic features within 1/4 mile of the facility or proposed facility.
- Map(s) showing locations of all borings, excavations, piezometers, and wells constructed for the study.
- Monthly piezometric maps per aquifer to be monitored. The maps must include labels showing water elevations next to each well or piezometer and must indicate the date when the water elevation was measured.
- Map(s) showing inferred results of geophysical explorations with survey tracks (if applicable).
- Map(s) locating cross-sections, and borings used in cross-section representation.
- Map(s) locating floodplains, wetlands and fault(s).
- Map delineating seismic impact zones.
- Bedrock contour maps (where applicable).

#### **5.10 - Cross-Sections**

- Geologic cross-sections should be constructed through all appropriate borings both perpendicular and parallel to the facility baseline as well as along and across all transects which include major geologic features such as faults, sinkholes, and buried valleys. At least one cross-section should be constructed parallel to groundwater flow. The subsurface conditions of the site should be illustrated in these cross-sections. Where more than one interpretation may be reasonably made, conservative assumptions should be used.

#### **5.11 - Aerial Photographs**

- One or more vertical aerial images, representing the entire area of the proposed site plus the area within 1/4 mile of the site should be included in the report.



## Appendix A – General Cost Estimate for Site Characterization

### Generalized Cost Estimate for Site Characterization

The following cost estimates are for the completion of drilling activities related to a detailed site characterization. The costs provided are approximate and obtained in August 2010. They may not reflect cost everywhere. The cost estimates do not include additional services, site visits or the installation of groundwater monitoring wells.

Piezometer installation in soil – \$46/ft includes boring, PVC and completion  
 Piezometer installation in bedrock – \$92/ft includes rock coring, PVC and completion  
 Geologist time – \$75/hour  
 Site Characterization Report – \$3,000  
 Monitoring well registration fees – \$100/well  
 Water level sampling fee – \$300/round

<b>Table No. 1 - Simple (1 to 5 acre) Site Cost Estimates</b>				
	Borehole – Soil boring with water level @ 10 feet	Borehole – Soil boring with water level @ 30 feet	Borehole – 20 foot soil and 40 foot bedrock, water level @ 50 feet	Borehole – 20 foot soil and 80 foot bedrock, water level @ 90 feet
Borings 3 required	3 @ \$46.00 X 20 foot = \$2,760	3 @ \$46.00 X 40 foot = \$5,520	3 @ \$46.00 X 20 foot = \$2,760  3 @ \$92.00 X 40 Feet = \$11,040	3 @ \$46.00 X 20 foot = \$2,760  3 @ \$92.00 X 80 Feet = \$22,080
Geologist Time	Two 10-hour days = \$1,500	three 10-hour days = \$2,250	Four 10-hour days = \$3,000	Five 10-hour days = \$3,750
Report	Report = \$2,000	Report = \$2,000	Report = \$4,000	Report = \$4,000
Well Registration	Well registration 3 @ \$100 = \$300	Well registration 3 @ \$100 = \$300	Well registration 3 @ \$100 = \$300	Well registration 3 @ \$100 = \$300
Water level Sampling	12 months = \$3,600	12 months = \$3,600	12 months = \$3,600	12 months = \$3,600
Total Cost	\$10,160	\$13,670	\$24,700	\$31,495

<b>Table No. 2 - Larger or Hydrologically Complex Site Cost Estimates</b>				
	Borehole – Soil boring with water level @ 10 feet	Borehole – Soil boring with water level @ 30 feet	Borehole – 20 foot soil and 40 foot bedrock, water level @ 50 feet	Borehole – 20 foot soil and 80 foot bedrock, water level @ 90 feet
Borings	10 @ \$46.00 X 20 foot = \$9,200	10 @ \$46.00 X 40 foot = \$18,400	10 @ \$46.00 X 20 foot = \$9,200  10 @ \$92.00 X 40 Feet = \$36,800	10 @ \$46.00 X 20 foot = \$9,200  10 @ \$92.00 X 80 Feet = \$73,600
Geologist Time	four 10-hour days = \$3,000	five 10-hour days = \$3,750	six 10-hour days = \$4,500	eight 10-hour days = \$6,000
Report	Report = \$3,000	Report = \$3,000	Report = \$5,000	Report = \$5,000
Well Registration	Well registration 10 @ \$100 = \$1,000	Well registration 10 @ \$100 = \$1,000	Well registration 10 @ \$100 = \$1,000	Well registration 10 @ \$100 = \$1,000
Water level Sampling	12 months = \$3,600	12 months = \$3,600	12 months = \$3,600	12 months = \$3,600
Total Cost	\$16,800	\$29,750	\$60,100	\$98,400

## REFERENCES

Missouri Department of Natural Resources (MDNR), January 2007, Missouri Environmental Geology Atlas (MEGA)

Missouri Department of Natural Resources (MDNR), January 2007, 10 CSR 80-2 (Appendix 1), Guidance for Conducting and Reporting Detailed Geologic and Hydrologic Investigations at a Proposed Solid-Waste Disposal Area. Available online: <http://www.dnr.mo.gov/geology/geosrv/envgeo/swmpapp1.htm>

Missouri Department of Natural Resources (MDNR), June, 1996, Missouri Well Construction Rules, 10 CSR 23-1.00 through 10 CSR 23-6.060, (Miscellaneous Publication No. 50)

United States Environmental Protection Agency (USEPA), 1993. Subsurface Characterization and Monitoring Techniques, A Desk Reference Guide, EPA/625/R93/003a and EPA/625/R-93/003b.

United States Environmental Protection Agency (USEPA), 1992b. RCRA Ground-Water Monitoring: Draft Technical Guidance. Office of Solid Waste, EPA 530R-93-001.

## F. MDNR Acronyms and Definitions

### Acronyms:

<u>Acronym</u>	<u>Stands for</u>	<u>Page first used</u>
AoR	Area of Review	9
bbls	Barrels	12
DEQ	Division of Environmental Quality	1
DHSS	Department of Health and Senior Services	1
EOR	Enhanced Oil Recovery	5
EPA	Environmental Protection Agency	1
ERP	Environmental Remediation Program	1
GWPC	Ground Water Protection Council	4
MDNR	Missouri Department of Natural Resources	1
MGs	Missouri Geological Survey	1
MI	Mechanical Integrity	15
MIT	Mechanical Integrity Test	6
MOA	Memorandum of Agreement	1
MOU	Memorandum of Understanding	1
MSOP	Missouri State Operating Permit	16
NOV	Notice of Violation	16
NPDES	National Pollutant Discharge Elimination System	8
NTW	National Technical Workgroup	19
QA/QC	Quality Assurance/Quality Control	16
QAPP	Quality Assurance Project Plan	16
QMP	Quality Management Plan	16
SDWA	Safe Drinking Water Act	1
SNC	Significant Noncompliance	17
SWD	Salt Water Disposal	5
TA	Temporarily Abandoned	6
TDS	Total Dissolved Solids	9
UIC	Underground Injection Control	1
USDW	Underground Source of Drinking Water	1
WMP	Waste Management Program	1
WPCB	Water Pollution Control Branch	16
WPP	Water Protection Program	1

### Definitions: Within Missouri Regulations:

(1) The terms used in 10 CSR 50 have the meanings set forth in section 259.050, RSMo, or this rule, unless the context of the term clearly indicates otherwise.

(A) Terms beginning with the letter A.

1. Abandoned site, any property or lease that is no longer operated as an active site for oil and gas production and injection projects.
2. Abandoned well, a well that is no longer operated for its intended use and has not been shut in, converted to another type of well, or plugged.

3. Area of review, an area surrounding an injection well(s) that extends a minimum of one-half (1/2) mile from the well(s) or from the unit boundary of an enhanced recovery project.
4. Area of review well, any well including, but not limited to, water wells, abandoned wells, plugged wells, and dry holes, located within the area of review, which penetrates the injection interval

(B) Terms beginning with the letter B. 1. (Reserved)

(C) Terms beginning with the letter C.

1. Casing, the impervious, durable, tubular materials used to line a wellbore.
2. Casinghead gas, gas produced that was in solution with oil in its original state in the reservoir.
3. Cement, portland cement or a blend of portland cement.
4. Coalbed natural gas, natural gas produced from either coal seams or associated shale.
5. Commercial well, a well from which oil or gas is recovered and sold, traded, or otherwise used for profit.
6. Common source of supply, synonymous with “pool” as defined in Chapter 259, RSMo.
7. Confining strata, geologic stratum or strata that serve as a barrier between water-, oil-, or gas-bearing strata.
8. Core, a continuous section of geologic materials recovered during drilling.
9. Corrective action, remedial action on any well to prevent the migration of fluids from the surface or from one (1) stratum to another.
10. Correlative rights, the right of each owner or operator in a pool to obtain that owner’s or operator’s just and equitable share of the oil or gas resource, or an economic equivalent of that share of the resource, produced in a manner or amount that will not have any of the following effects: A. Damage the reservoir; B. Take an undue proportion of the obtainable oil or gas; or C. Cause undue drainage between developed leases.
11. Council, the State Oil and Gas Council established by section 259.010, RSMo.

(D) Terms beginning with the letter D. 1. (Reserved)

(E) Terms beginning with the letter E.

1. Enhanced recovery, any process used to increase the recovery of oil or gas from a pool through secondary or tertiary recovery. Enhanced recovery includes, but is not limited to, water floods, pressure maintenance projects, cycling or recycling projects, steam floods, fire floods, carbon dioxide injection projects, high-density well drilling projects, and approved technologies that are either unconventional or in any way redirect the natural movement of oil or gas or formation water in the pool. Enhanced recovery typically involves the use of injection wells of some kind as part of a production unit.



2. Enhanced recovery injection well, an injection well used to move underground fluids to production wells through the use of water, steam, gas, or any other substance in order to redirect or facilitate the natural movement of oil, gas, or water in a pool.
3. Exempted aquifer, an aquifer or its portion that meets the criteria in the definition of Underground Source of Drinking Water set forth in paragraph (1)(U)1. of this rule but which has been exempted for operation of an injection well.

(F) Terms beginning with the letter F.

1. Fluid, any material or substance which flows or moves whether in a semisolid, liquid, sludge, or gaseous state.
2. Formation water, water that occurs naturally within the pores of a geologic formation or stratum.

(G) Terms beginning with the letter G. 1. (Reserved)

(H) Terms beginning with the letter H.

1. Horizontal well, a well drilled at an angle to the vertical, typically parallel to the geologic strata containing oil or gas.

(I) Terms beginning with the letter I.

1. Increased well density, the drilling of an additional primary production well in a spacing unit.
2. Injection, emplacement of fluids into the subsurface through a well.
3. Injection well, a well into which fluids are injected during all or part of the life of the well for disposal or enhanced recovery projects or for underground storage of gas that is liquid at standard temperature and pressure, but not including oil- or gas-producing wells undergoing approved well stimulation treatment.
4. Injection zone, a geological stratum, group of strata, or part of a stratum that receives fluids through a well.

(J) Terms beginning with the letter J. 1. (Reserved)

(K) Terms beginning with the letter K. 1. (Reserved)

(L) Terms beginning with the letter L.

1. Location exception, authorization given by the state geologist to drill a well at a location other than that which is prescribed by these regulations.

(M) Terms beginning with the letter M.

1. Mechanical integrity, a well has mechanical integrity if there is no significant leakage in the casing, tubing, or packer; and there is no significant fluid movement into an underground source of drinking water through vertical channels adjacent to the wellbore.

2. Missouri nomenclature, Missouri specific geologic terminology as provided by the state geologist including, but not limited to, names of geologic strata, pools, and geologic features.
3. Multiple completion, the completion of any well that permits production from two (2) or more pools that are completely segregated by confining strata.

(N) Terms beginning with the letter N. 1. (Reserved)

(O) Terms beginning with the letter O.

1. Observation well, a well that is used to monitor the operational integrity and conditions of oil, gas, and storage operations, including physical or chemical parameters of a reservoir or geologic formation or strata, and is not used currently as a production, injection, disposal, or water well.
2. Oil and Gas Remedial Fund, the fund established by section 259.190.5, RSMo into which forfeited bond monies and proceeds from the sale of illegal oil, illegal gas, and illegal product are deposited, which is to be used for plugging abandoned wells as provided for in 10 CSR 50-2.060(3)(F).
3. Oil and Gas Resources Fund, the fund established by section 259.052, RSMo, into which all gifts, donations, transfers, moneys appropriated by the General Assembly, permit application fees, operating fees, closure fees, late fees, severance fees, and bequests are deposited, which is to be used to administer the provisions of Chapter 259, RSMo, and implementing regulations, and to collect, process, manage, interpret, and distribute geologic and hydrologic resource information pertaining to oil and gas potential.
4. Open well, a well that has not been plugged including, but not limited to, abandoned, operating, or shut-in wells.
5. Operator, a person who drills, maintains, operates, or controls wells associated with oil or gas production, storage, or injection projects.

(P) Terms beginning with the letter P.

1. Person, any individual, partnership, co-partnership, firm, company, public or private corporation, association, joint stock company, trust, estate, governmental or political subdivision, or any other legal entity.
2. Plugged well, a well that has been filled or partially filled with cement or other materials to prevent the migration of fluids within the well.
3. Pooling, the contractual agreement of those holding the rights to mineral interests within a single spacing unit for primary production, whether that agreement is voluntary or by order of the council, to produce oil or gas or both from that unit.
4. Primary production, the process of recovery of oil or gas from a pool in which one (1) well is capable of efficiently draining the pool or portion thereof that resides within the confines of the spacing unit and the drainage of oil, gas, or formation water into the well occurs naturally.
5. Private domestic consumption, gas used from an on-site well(s) for the sole purpose of providing gas for a private dwelling or business and not for resale or trade.

6. Produced water, formation water that is associated with the production of oil or gas and either requires disposal or is used as part of an enhanced recovery project.
7. Production unit, an uninterrupted block of acreage of any size and any shape that has a definite outer boundary and in which wells may be drilled for enhanced recovery. The acreage that composes a production unit may include default spacing units, acreage for which spacing units have or have not been explicitly ordered by the state geologist or council, pooled or non-pooled mineral acreage, and all or parts of past and present production units.
8. Production well, any well used for recovery of oil or gas or both.

(Q) Terms beginning with the letter Q. 1. (Reserved)

(R) Terms beginning with the letter R.

1. Recompletion, the process of reworking or repairing a well after its initial well completion.
2. Reference well, a well used to collect data to establish a maximum injection pressure as approved by the state geologist.

(S) Terms beginning with the letter S.

1. Seismic shot hole, a hole drilled for the purpose of generating a seismic signal to be used in the exploration or development of oil or gas or both.
2. Shut-in well, any well that has not been operated for ninety (90) calendar days or more.
3. Spacing Unit, an arbitrary block of acreage of specified size and shape for a single pool that is based on the U.S. Public Land Survey System in which only one (1) production well may be drilled for primary production that is no closer than a specified minimum distance from the unit boundary.
4. Special project, research and development of a new process or technology that increases the amount of oil or gas recoverable from a pool or improves oil or gas operations.
5. Spill or release, any threatened or real emission, discharge, spillage, leakage, pumping, pouring, emptying, or dumping of a substance into or onto the land, air, or waters of the state, unless done in compliance with the conditions of a federal or state permit, unless the substance is confined and is expected to stay confined to property owned, leased, or otherwise controlled by the person having control over the substance.
6. Spud date, the date of first penetration of the earth with a drilling bit.
7. Storage well, a well used to inject or extract natural gas or other gaseous hydrocarbons for storage purposes.
8. Stratum or strata, a layer or layers of rock composed of substantially the same lithology that is distinctive visually from other layers above and below; often a lithologic unit.
9. Stratigraphic test well, a well drilled to obtain information on the thickness, lithology, sequence, porosity, permeability, or any other properties of rock, or to locate the

position of a geologic horizon in the evaluation of potentially productive oil or gas strata and is not utilized for generating a seismic signal.

(T) Terms beginning with the letter T. 1. (Reserved)

(U) Terms beginning with the letter U.

1. Underground source of drinking water, an aquifer or any portion thereof that — A. Supplies any private well or public water supply system; or B. Contains a sufficient quantity of groundwater to supply a private well or public water system; and (I) Currently supplies drinking water for human consumption; or (II) Contains less than ten thousand (10,000) mg/L total dissolved solids; and C. Is not an exempted aquifer.
2. Unitization, the contractual agreement of mineral interests owners to form a production unit through a voluntary process or order of the council, to produce oil or gas from that production unit and to designate the operator of the unit.

(V) Terms beginning with the letter V. 1. (Reserved)

(W) Terms beginning with the letter W.

1. Waters of the state, has the same meaning as defined in the Missouri Clean Water Law, section 644.016, RSMo.
2. Well, has the meaning as defined in section 259.050(16). Wells drilled for the production of water are regulated by the Water Well Drillers' Act, Chapter 256, RSMo, and the implementing Missouri Well Construction rules, 10 CSR 23. A well includes, but is not limited to, the following: A. Disposal well; B. Enhanced recovery injection well; C. Horizontal well; D. Injection well; E. Observation well; F. Production well; G. Seismic shot hole; H. Storage well; or I. Stratigraphic test well.
3. Well stimulation treatment, a treatment of a well designed to enhance oil and gas production or recovery by increasing the secondary permeability of the geologic strata. Well stimulation is a short-term and non-continual process for the purposes of opening and stimulating channels for the flow of oil or gas or both. Examples of well stimulation treatments include hydraulic fracturing, acid fracturing, and acid matrix stimulation. Well stimulation treatment does not include routine well cleanout work; routine well maintenance; routine treatment for the purpose of removal of geologic strata damage due to drilling; bottom hole pressure surveys; routine activities that do not affect the integrity of the well or the geologic strata; the removal of scale or precipitate from the perforations, casing, or tubing; or a treatment that does not penetrate into the geologic strata more than thirty-six (36) inches from the wellbore.
4. Whipstock, a long wedge-shaped steel device or casing that uses an inclined plane to cause the bit to deflect from the original borehole at a slight angle, sometimes used in an oil or gas well to control directional drilling, to straighten crooked boreholes, or to sidetrack to avoid unretrieved items left in a well.

(X) Terms beginning with the letter X. 1. (Reserved)

(Y) Terms beginning with the letter Y. 1. (Reserved)

(Z) Terms beginning with the letter Z. 1. (Reserved)

(2) All other words used in this rule have their usual customary and accepted meaning, and all words of a technical nature, or specific to the oil and gas industry, will be given that meaning which is generally accepted in the oil and gas industry.



## G. MDNR 1422 Program Evaluation Questionnaire Responses

### Comprehensive Program Evaluation of the Missouri

#### Safe Drinking Water Act Section 1422

#### Underground Injection Control (UIC) Program

##### General Program

##### A. Statutory Authorities and Regulatory Jurisdictions

1. What year did EPA grant primary authority to your agency for permitting and regulating Class I, III and V injection wells?

EPA granted primacy to the State of Missouri's Department of Natural Resources effective December 2, 1983.

2. What is the state statutory authority upon which Missouri's 1422 UIC program is based?

Missouri's UIC program regulates the Classes I-V wells as follows:

##### Class I

Class I injection wells are **banned** in Missouri by Section 577.155, RSMo. This law is a general ban on waste injection, except in specified instances, prohibiting hazardous waste injection. The Department's Division of Environmental Quality (**DEQ**) is also responsible for enforcing the prohibition on Class I wells under the Missouri Clean Water Law (Chapter 644, RSMo).

##### Class II

Class II injection wells are regulated by the Missouri Geological Survey (**MGS**) through the State Oil and Gas Council per Chapter 259, RSMo.

##### Class III

Class III injection wells are regulated through the Clean Water Commission under 10 CSR 20-6.090. This regulation requires those wishing to operate Class III wells to obtain a permit from the Water Protection Program (**WPP**) under the Missouri Clean

Water Law, Chapter 644, RSMo. To date, no permits have been issued in Missouri for this well class.

#### Class IV

Class IV injection wells are banned in Missouri by Section 577.155, RSMo. These wells

also are banned nationwide under the federal UIC regulations. **DEQ** is responsible for enforcing the prohibition on Class IV wells under the Missouri Clean Water Law (Chapter 644, RSMo).

#### Class V

Class V injection wells include a variety of different well types. These wells are regulated by **DEQ**, the Department of Health and Senior Services (**DHSS**), **MGS**, and county health departments. These wells generally are used to inject non-hazardous fluids into, or above, an Underground Source of Drinking Water (USDW).

Class V injection wells in Missouri are regulated as follows:

**Onsite Waste Water Treatment Systems with Drainfield Disposal** – Onsite Waste Water Treatment Systems that place fluid into the subsurface via a perforated pipe or similar conveyance are Class V injection wells, excluding single-family residences and non-residential systems serving less than 20 persons a day. A 2011 Memorandum of Understanding (MOU) between **DEQ**, **DHSS**, and **MGS** outlines the responsibilities of each agency concerning the investigation, assessment, and control of physical, chemical, radiological, and biological agents in the environment. Onsite systems with a discharge of more than 3000 gallons per day are permitted by **WPP** under the Clean Water Commission under 10 CSR 20-7.015. Systems with a discharge of 3000 gallons per day or less are permitted by **DHSS** or by county health departments that have adopted by ordinance minimum state standards. State standards for on-site disposal systems can be found in Chapter 701, RSMo.

What approach, and which program, would be used if an onsite waste water treatment system were seeking to dispose of fluids other than sanitary wastes?

Several permits which allow groundwater, permit land application. Similar as domestic, with DHSS would be considered as domestic as referenced through MOU. If no route then MDNR works with applicant to figure out solution through NPDES, trucking, etc. Don't do site specific for industrial wastewater or general permits. Slaughterhouse has a no discharge pushed towards. Mortuaries are more addressed through public sewage. Not seeing rural septic system injection for mortuary use.

**Groundwater Remediation Wells** – These injection wells are used in the cleanup of contaminated sites and were permitted by **WPP** through the Clean Water Commission under 10 CSR 20. A 2004 MOU between **WPP** and the Hazardous Waste Program (**HWP**) transferred authority for approving remediation projects involving injection at hazardous waste sites to the **HWP**. No UIC Class V permit or approval is required from **WPP** for injection projects as long as the terms of the MOU are met. Construction of remediation wells is regulated by **MGS** under the Missouri Well Construction Rules,

10 CSR 23, Chapter 5 (statutory authority lies in Sections 256.600-256.640, RSMo). The coordination document developed in response to the MOU also requires a Class V Inventory form submission to **MGS** for inclusion in the required reporting to EPA.

**Mine Backfill Wells** – Mine backfill wells are permitted by **WPP** through the Clean Water Commission under 10 CSR 20 (Chapter 644, RSMo).

**Heat Pump/Air Conditioning Return Flow Wells** – Heat pump systems used by more than eight single-family residences or rated at 600,000 British Thermal Units per hour or more are permitted by the **WPP** under 10 CSR 20-6.070 (Chapter 644, RSMo). Return well construction is regulated by **MGS** under 10 CSR 23, Chapter 5 (Sections 256.600-256.640, RSMo).

**Aquifer Recharge Wells** – Permits for recharge wells are issued by **WPP** through the Clean Water Commission under 10 CSR 20 (Chapter 644, RSMo), with review by **MGS** personnel.

**Abandoned Water Wells Used for Waste Disposal** – Section 577.155, RSMo, **does not allow** injection into wells for the purposes of waste disposal. Enforcement of the Missouri Clean Water Law (Chapter 644, RSMo) by **WPP** and the Missouri Well

Construction Rules by **MGS** would address any occurrence of these wells (Sections 256.600-256.640, RSMo).

**Storm Water Drainage Wells** – These systems are permitted by **WPP** through the Clean Water Commission under 10 CSR 20 (Chapter 644, RSMo).

**Improved Sinkholes** - **WPP** does not currently enforce permit requirements for this type of well. Promulgation of a rule authorizing the construction and operation of this type of well has been discussed by **WPP** and **MGS** staff.

While improved sinkholes are a classification of well it is not typically used as a descriptor for the type of injection occurring (i.e. aquifer recharge wells, storm water drainage wells). What types of fluids does Missouri allow to be emplaced into an improved sinkhole? Without enforcing permit requirements for improved sinkholes does Missouri conduct any investigation to ensure USDWs are not being endangered by contaminants emplaced during operations?

Most may be agricultural in nature along with stormwater, many single-family systems may discharge to sinkholes. MDNR has come across industrial situations with sinkholes that open; most in Perry County. For proper “improved sinkholes” if found fluids that were not agricultural or stormwater, MDNR would address as needed. Straight pipes to sink holes very common, but these are being addressed. Jurisdiction under DHSS. Some were pipers were placed into the sinkhole to stabilize its banks and reduce erosion. Southwest part of state used LIDAR to ensure nothing in proximity of sinkhole.

3. Does your statutory authority include the ability to promulgate new rules or modify existing ones? If so, please describe and cite the enabling authority or authorities.

Rulemaking authority lies in Section 644.026, RSMo (Water Protection); Section 256.606, RSMo (Well Construction); and Section 701.033(1), RSMo (Onsite Wastewater Treatment Systems).

4. In general terms, please describe any changes have been made to the regulations since primacy was granted and how those changes have impacted the UIC program?

Numerous regulatory changes have been promulgated since primacy was granted. In general, there have not been significant changes to state regulations that impact implementation of the UIC program since primacy.

What are these changes? We know about the recent changes to the 1425 program but what has changed in the 1422 program over time?

1422 related rules and regulations which were updated did not directly relate to the UIC program.

5. How does MDNR facilitate communication with other groups that may deal with UIC issues within MDNR and other local state and federal agencies?

**MGS** conducts periodic face-to-face UIC coordination meetings and sends emails to communicate with other entities concerning UIC issues, updates, and requests for information.

Examples of this communication?

Started having annual meetings, prior to that periodic and occasional face-to-face meetings. Currently working on communication with UIC topics across the state as a whole. Currently having quarterly ERP meetings. On-going discussions on data accumulation and its efficiency. Potential problems with small systems due to no regulatory hook to require it (potentially). Going door to door with MGS to describe the reasons.

**WPP** has participated in Region 7 coordination meetings and has sought input on implementation from Kansas, Nebraska, Iowa, and Oregon. Permits are coordinated with MGS prior to issuance. The permittee is granted a negotiation period during permit development that allows the permittee and its consulting firm or firms to have some input on the permit. Additionally, permits undergo a public participation process, as required by statute and regulations. This allows anyone to provide input during the permit development.

**DHSS** provides information on Class V wells that are permitted through DHSS in accordance with the MOU with MDNR.

6. Does MDNR have any MOAs or MOUs with other programs in place to ensure that communication and/or coordination is and can be conducted effectively?

Yes

- If so, please provide a list of the current MOAs/MOUs and discuss how effective they have been.

- 2000 MOU between the Water Protection Program and the Solid Waste Management Program.
- 2004 (9/30/2004) MOU between the Water Protection Program and the Hazardous Waste Program.
- 2011 MOU Missouri Department of Natural Resources/Missouri Department of Health and Senior Services.
- MOUs have been effective at establishing roles and responsibilities for implementation of the UIC program.

How effective have these MOUs been for facilitating internal communication/coordination between programs?

ERP's MOU has been revised and under review. DHSS MOU is currently being reviewed. DHSS related regs being updated and MOU will be updated subsequently. MDNR is looking to put rules on when these are revised and updated. Updated regs are in the process of approval but have languished (DHSS). Path forward on moving them forward. Have an old EPA authorization letter which needs updated (this was addressed earlier during the crosswalk discussion).

MDNR – will provide what updates to the MOUs are being made.

B. Administrative and Program Development

1. Please provide an agency organizational chart and identify UIC positions along with their roles and responsibilities.

Given the changes which have occurred to the MGS UIC program since this submission, please provide an updated organizational chart for that portion of the

UIC program along with any other changes in the organizational structure which have occurred to the other UIC related programs within MDNR.

MGS has changes, no response needed now, just confirmation letter.

MDNR: Carol Comer, Director

Missouri Geological Survey:

**Joe Gillman**, Director and State Geologist

**Amber Steele**, Director - Geological Survey Program

**Larry Pierce**, Chief - Geological Resources Section

**Chris Vierrether**, Chief - Energy Resources Unit; Coordination and management of 1422 Program and 1422 Program reporting to EPA.

**Jeff Crews**, Geologist; UIC 1422 Program well data acquisition, data management, well inventory collection and update, modifications to aquifer inventory, public awareness, data retrieval, and technical assistance and support.

**Kyle Rollins**, Chief - Well Installation Section; Coordinates compliance and enforcement for well construction and plugging of certain Class V well types (i.e., groundwater remediation wells, heat pump/air conditioning return flow wells, and abandoned water wells used for waste disposal).

**Justin Davis**, Chief - Well Installation Field Investigations Unit; Ensures compliance for well construction and plugging of certain Class V well types (i.e., groundwater remediation wells, heat pump/air conditioning return flow wells, and abandoned water wells used for waste disposal).

**Sherri Stoner**, Chief – Environmental Section

**Jeremiah Jackson**, Chief – Environmental Assistance Unit; Supervise and coordinate work performed for UIC related projects.

**Fletcher Bone**, Geologist; performs geohydrologic evaluations and document reviews for UIC related projects.

**John Corley**, Geologist; performs geohydrologic evaluations and document reviews for UIC related projects.

**Kirsten Schaefer**, Geologist; performs geohydrologic evaluations and document reviews for UIC related projects.

**Molly Starkey**, Geologist; performs geohydrologic evaluations and document reviews for UIC related projects.

**Brenna McDonald**, Chief – Underground Tanks Unit

Peter Bachle, Geologist

Terry Hawkins, Geologist

**John Pate**, Geologist

Division of Environmental Quality:

**Edward Galbraith**, Director – Division of Environmental Quality

**Chris Wieberg**, Director - Water Protection Program

**Michael Abbott**, Chief - Operating Permits Section

**Tim Bull**, Chief - Domestic Waste Unit

**Heather Peters**, Chief - Industrial Permits Unit

**Pam Hackler**, Environmental Scientist - Industrial Permits, UIC Permits

**John Jurgensmeyer**, Director – Environmental Remediation Program

**Chris Nagel**, Director – Waste Management Program

**Bobbie Pennington** – UIC Coordinator for Environmental Remediation Program and Waste Management Program; duties include: UIC data acquisition and management for underground injection projects for remediation sites and technical assistance and support to project managers.

DHSS:

**Dr. Randall Williams**, Director – Missouri Department of Health and Senior Services

**Adam Crumbliss**, Director – Division of Community and Public Health

**Jonathan Garoutte**, Chief – Section of Environmental Public Health

**Eric Hueste**, Chief – Bureau of Environmental Health Services

**Eric Folks**, Manager – Onsite Wastewater Treatment Program

2. What training is required for new UIC staff?



MGS:

- Familiarize themselves with federal, state, and county regulations and policies affecting the 1422 Program
- Attend training concerning the geology and hydrology of Missouri
- Attend UIC inspector training as opportunities are made available
- Attend UIC EPA/Four State meetings as funding allows
- Attend Groundwater Protection Council conferences as funding allows

WPP:

- Take online and in-person National Pollutant Discharge Elimination System (NPDES) permit writers training
- Familiarize themselves with federal and state clean water permitting laws and regulations
- Participate in on-the-job training on issues specific to UIC permits
- UIC EPA/Four State Meeting as funding allows

Environmental Remediation Program (ERP) – formerly Hazardous Waste Program or HWP:

- Project managers within ERP and Waste Management Program (WMP) – formerly Solid Waste Management Program – are required to familiarize themselves with federal, state, and county regulations and policies affecting UIC projects.

3. What training or workshops pertinent to the UIC program has MDNR staff been able to take or attend in the past year?

MGS:

- 2018 Groundwater Protection Council Forum – September 10-13, New Orleans, LA
- 2018 UIC EPA/Four State meeting – December 6-7, Lenexa, KS
- 2019 Groundwater Protection Council Conference – February 25-27, Fort Worth, TX
- 2019 On-Site Installer Training Course – March 13, Buffalo, MO
- 2018 Missouri Small Flows Organization: Soils and Drip Irrigation
- Interstate Technology & Regulatory Council (ITRC) - Characterization and Remediation of Fractured Rock
- 2018 and 2019 Missouri Waste Control Coalition Conference

- Midwest Geosciences webinar - Managing Groundwater Storage
- Central States Forestry Soils Workshop
- Mt. Sopris Downhole Geophysics Tools Training
- National Ground Water Association (NGWA) - Applications of Groundwater Geochemistry
- NGWA - Water Quality: Public Health v. Well Health
- Aquifer Testing for Improved Hydrogeologic Site Characterization

ERP:

- 2018 Groundwater Protection Council Forum – September 10-13, New Orleans, LA
- 2018 UIC EPA/Four State meeting – December 6-7, Lenexa, KS
- 2019 Groundwater Protection Council Conference – February 25-27, Fort Worth, TX
- 2019 On-Site Installer Training Course – March 13, Buffalo, MO

4. What UIC related public education/outreach activities have MDNR conducted in the past year?

Jeff Crews (MGS) presented an overview of the UIC program and inventory requirements to the Multi-County Onsite Wastewater Training in Buffalo, Missouri. The course was attended by installers, soil evaluators, licensed loan inspectors, and county health department staff.

5. What type of technical assistance has the state provided to the public or regulated community regarding about the UIC program and its requirements?

**MGS:** Assisted the public with submitting inventory information, understanding rules and regulations, and contacting the proper permitting authority for various types of injection. MGS also performs geohydrologic evaluations for wastewater treatment facilities that include subsurface absorption systems, lateral lines, etc. The interpretations and recommendations in these reports are used to assist permit writers determine appropriate limitations. MGS reviews technical documents to determine the suitability and feasibility of sites to be protective of groundwater. In addition, MGS provides technical review and assistance to facilities for site characterization activities.

**WPP:** A fact sheet is written for every UIC permit issued. This fact sheet explains the UIC permit and the basis for the permit conditions and requirements. The fact sheet

is provided with the permit during the public comment period. WPP therefore provides site-specific assistance with each UIC permit.

A technical bulletin on UIC is also available on our webpage: <https://dnr.mo.gov/pubs/pub221.pdf>. It includes information on UIC regulatory requirements and other guidance.

**ERP:** When requested, ERP and WMP project managers will provide regulatory and technical guidance to stakeholders to complete Conceptual Site Models and UIC work plans. This includes providing a copy of the attachment to the 2004 Memorandum of Understanding (MOU).

**DHSS:** Has not provided such technical assistance.

6. Does the state have a staff development plan to keep staff up-to-date on issues related to the UIC program?

**MGS:** Staff members attend MGS - Energy Resources Unit informational meetings, EPA UIC Region 7 meetings, annual GWPC Conferences and Forums, required webinars as available, and other informational opportunities as resources allow.

**WPP:** Industrial permit writers regularly look for training or learning opportunities related to industrial permits, including UIC permits.

**ERP:** Is currently drafting a policy document that details all the UIC duties and tasks within ERP. It is expected that this document will help with consistency and transparency with UIC procedures and communication.

**DHSS:** Does not have such a staff development plan.

7. Has MDNR conducted outreach/education activities aimed at educating the public or other programs within MDNR about the UIC program?

**MGS:** Coordinated a UIC program meeting with DNR programs and DHSS staff to review roles and responsibilities as well as the UIC program review.

**WPP:** A fact sheet is written for every UIC permit issued. This fact sheet explains the UIC permit and the basis for the permit conditions and requirements. The fact sheet is provided with the permit during the public comment period.

A technical bulletin on UIC is also available on our webpage:

<https://dnr.mo.gov/pubs/pub221.pdf>. It includes information on UIC regulatory requirements and other guidance.

**ERP:** Is currently drafting a policy document that details all the UIC duties and tasks within ERP. It is expected that this document will help with consistency and transparency with UIC procedures and facilitate communication for remediation projects. It is being designed to be updated as needed and used as a way to communicate with personnel.

**DHSS:** Has not conducted any such outreach/education activities.

#### C. Resources

1. Does the State foresee in the near future problems in meeting their current workplan goals and projections?

No

2. Are current funding levels for staff adequate for full UIC program implementation?

Federal UIC funding levels are adequate to support the inventory and reporting of the UIC program. State funding supports permitting, inspection, and enforcement activities. Overall, funding is adequate.

3. How many field inspectors total does the State employ for UIC inspection activities?

**MGS:** Has 0.5 FTE (geologist) who assists with 1422 Program UIC inspections in an advisory role. Five geologists in the Geological Survey Program assist in geologic and hydrologic site characterizations. Additionally, four field inspectors (geologists, environmental specialists, and technical assistants) perform well construction and plugging compliance investigations.

**WPP:** Has at least one inspector available per region to cover any needed UIC inspections or issues.

**ERP:** There are 52 positions within ERP and WMP that may assist with inspections in an advisory role. These environmental positions include: 25 Environmental Engineers, 1 Geologist, 4 Environmental Scientists, 18 Environmental Specialists, and 4 Environmental Supervisors.

D. Well Inventory and Operations

1. How many active Class V injection wells are in your inventory at this time?

There are 8077 active UIC Class V wells as of May 17, 2019.

2. Are there any wells which are in temporarily abandoned status and if so, what oversight occurs of those wells to ensure compliance?

There are 636 various well types inventoried and temporarily abandoned. 492 of these are abandoned water wells. Previous desk reviews of these abandoned water well records rarely show that the well was used for any kind of injection. It is more common that the records were created early in the implementation of the UIC program and that the wells were inventoried as abandoned water wells that theoretically could be used for injection. The sources of these records are typically certification records submitted by drillers. Further review of these records of abandoned water wells is needed as resources become available.

Does Missouri ever conduct investigations into these wells to ensure they are not actively being used as injection wells? If not, what situations may warrant an investigation by the State?

Not being done in water due to a lack of resources. If a complaint were received it would be investigated by MDNR. DHSS no regs to verify system meets there needs, so try to educate. Water well transfers require re-registration.

Generally, well construction and plugging reports are reviewed to determine compliance with rules. Wells regulated by the Missouri Well Construction Rules that have not been in use for a period of two or more years and are in a state of disrepair must be plugged.

3. How many of these wells have been verified and how often are they inspected or the owners contacted to make sure that the well is still in operation and in compliance with the program requirements?

**WPP:** NPDES and state permitted facilities are regularly inspected by staff in regional offices throughout the state. Inspections include review of conditions relevant to UIC at these permitted facilities.

What kind of wells are these?

These would be septic systems, staff trained on clean water law, so inspections are based on permits which indicated groundwater not polluted. Other are mine backfill and inspections are based on permit conditions.

DHSS does not allow surface discharge (with exception of single families).

**ERP:** Conducted 630 routine or periodic inspections for open UIC Class V wells as of April 5, 2019.

When did the clock start for the 630 inspections?

Federal fiscal year.

4. Which wells covered by the UIC program need to obtain a permit and how is that determined?

**WPP:** Water permits are required for Class III and some Class V wells. Heat pump wells, mine backfill or stabilization wells, aquifer recharge wells, and discharges into sinkholes typically require a water permit. Groundwater remediation wells also require a permit but may be authorized through the primary remediation program with approval or consultation with the WPP.

In what situations may remediation wells be authorized through the primary remediation program instead of through a WPP issued permit?

Covered through the MOU process.

**DHSS:** Class V wells are permitted by DHSS for the installation only and not the operation.

Does DHSS have any specific rules/regulations for on-site waste water treatment systems with drainfield disposal other than the general regulation on contaminating groundwater within the state?

No specific rules outside of the general.

5. If it is determined that a well will require a permit, what is the general amount of time it takes from a permit application being received and a permit being finalized?

**WPP:** The length of time to issue a permit to inject is dependent on permit type (general or site-specific), completeness of the application, the complexity of draft permit discussions (public inquiry), and other site-specific criteria (complex geology). Permits are typically issued within 60 days (general) or 180 days (site-specific) of receipt of application.

The minimum amount of time for an injection plan for a remediation project to be approved is two weeks. This assumes all documentation has been submitted and a detailed Conceptual Site Model has been reviewed and approved by a project manager.

**DHSS:** For permits issued by DHSS, it depends on the type of system and possible variances. The permit issued by DHSS is only for the installation of the system.

What is involved in a variance? Do the permits state "only sanitary wastes"?

Not monitored, variance process same for any type of process. Should not take long, from 1 month to a year or two. Variances to setbacks, horizontal/vertical variances and require additional information to approve.

6. When developing a permit for an injection well, how is the area of review (AoR) determined?

**WPP:** The AoR for UIC permitting is determined based on the site geology, site characteristics and features, the injected material and injection rates, and proximity to groundwater, drinking water, and waters of the state (which includes all WOTUS). The WPP consults with MGS, uses a GIS system that tracks geologic, soil, well, and other relevant information (like sinkhole locations), and requests any other information necessary to determine the appropriate AoR and feasibility of UIC at the location.

**ERP:** For remediation projects the AoR is determined by the extent of expected impact for each well or group of injection points or injection trench. Injection projects are site-specific and generally designed to impact only the area of contamination.

**DHSS:** Uses soil morphology reports as well as setback distance requirements.

Does Missouri ever utilize a fixed radius area of review?

Follow MGS 100' private, 300' public, 100' heat pump rules. Wastewater permits would follow similar setbacks. UIC specific well based on hydrology and geology of site as site specific permit is developed. Some sites can be very large in depth.

7. How is the corrective action for wells found to be deficient in the AoR handled?

Corrective action for wells deficient in the AoR is handled on a case-by-case basis.

If an abandoned or improperly plugged well within the established AoR were found to provide an avenue for the injected fluid to migrate out of the permitted injection zone, what steps could MDNR take to ensure any USDW at the location were not endangered?

There are tools/regs available to do corrective action. Can be tricky. Permitted sites have regs requiring Missouri clean water law could require remedial actions up to plugging and abandonment.

8. What are the state's public notice requirements for a Class V well permit?

**WPP:** Site-specific water permits are placed on public notice for at least 30 days, with an opportunity for a public meeting, should one be appropriate. Wells covered under a general permit may not be published for public notice by site, but the terms and conditions of any issued general permit include a robust public notice and comment period. If a site cannot or does not meet general permitting requirements, a site-specific permit may be required, with the site-specific public notice and comment period.

**ERP:** Public notice requirements are based on site-specific requirements and dependent on section oversight and regulatory standards used. If underground injection is part of a remedy selection, a public comment period is required. Certain hazardous waste permit modifications would also require public notice. There may also be notification requirements if contamination has migrated off-site and



underground injection is used for remediation. 10 CSR 20-6.020 describes this public participation process.

What methods does MDNR use to notify the public of the opportunity to comment or request a hearing (i.e. mailout, newspaper)?

For superfund, public meeting staged along the way and is well addressed.

Site specific permits are published on MDNR website for public use. Permits are required to be posted on-site of the well and at the local county clerk's office.

9. What is considered when permitting/authorizing on-site systems and the geologic setting part of those considerations?

**MGS:** Geohydrologic evaluations collect, analyze, and interpret the thickness, type(s), and permeability of surficial materials and bedrock to help determine the potential for contamination. Other site-specific characteristics are also evaluated.

**WPP:** UIC permitting is determined based on-site geology, site characteristics and features, the injected material and injection rates, and proximity to groundwater, drinking water, and waters of the state (which includes all WOTUS). The WPP consults with MGS, uses a GIS system that tracks geologic, soil, well, and other relevant information (like sinkhole locations), and requests any other information necessary to determine the appropriate AoR and feasibility of UIC at the location.

**ERP:** The attachment to the 2004 Memorandum of Understanding (MOU) between WPP and HWP lists the minimum requirements that must be considered for a remediation injection project. Other actions may be required depending on the project and site conditions. Minimum requirements include: purpose of injection, contaminants and concentrations of contaminants, soil type(s), depth and volume of soil contamination, geologic setting including bedrock description, proximity of monitoring and domestic use wells, proximity of an aquifer, and groundwater flow.

**DHSS:** Uses soil morphology reports as well as setback distance requirements. DHSS also looks at the topography of the land.

10. How is the maximum operating pressure for an injection well determined (e.g. calculated maximum, step rate testing)?

**WPP:** Depending on well type, maximum operating pressures/flow rates for injection wells are based on site-specific geology and soil data; soil scientist analysis

of loading rates; certified engineer's design, construction, and operating plans; and reviews from MGS.

**ERP:** For remediation projects, operating pressures are usually based on site-specific conditions. An injection work plan may provide calculated theoretical operating pressures or procedures for step rate testing.

11. How are well completion and well workovers handled?

**WPP:** Well workovers may require permit modifications for site-specific injection wells.

What are some examples of past permit modifications required for well workovers?

No examples.

**MGS:** Wells used for remediation projects are required to comply with the Water Well Driller's Act, Sections 256.600 to 256.640, RSMo. Report of well construction/reconstruction is required 60 days after work is completed pursuant to Section 256.614, RSMo.

**DHSS:** Registered installers construct the system while DHSS staff review the documentation.

12. How does the state determine the competency of the confining zone(s) surrounding an injection zone?

The state requests a Hydrogeologic Site Characterization be performed at the site by following the Guidance for Conducting a Detailed Hydrogeologic Site Characterization and Designing a Groundwater Monitoring Program. The state recommends in-situ conductivity testing (i.e. packer tests, slug tests) to determine permeability in the expected confining unit. Characterization reports are submitted by facilities or their consultants and reviewed by geologists for technical viability and accuracy.

Most remediation sites do not affect an aquifer or drinking water source. If a remediation project will inject materials into an aquifer or is in a karstic or other geologically sensitive location, MGS would be contacted for further guidance and analysis.

13. What regulations or construction standards are in place to ensure that fluids don't move between aquifers or that injected fluids do not migrate to non-injection zones?

**WPP:** Chapter 644, RSMo, prohibits any person from causing pollution to any waters of the state, which in Missouri include groundwater. 10 CSR 20, Chapter 7 establishes groundwater quality standards. 10 CSR 20, Chapter 6 establishes permitting requirements to ensure protection and/or monitoring of groundwater, when appropriate. 10 CSR 20, Chapter 8 requires engineering reports and plans to include depth to groundwater, drinking water supplies, geologic conditions, soils, and limiting layers.

**MGS:** 10 CSR 23-3.090 (11) and 10 CSR 23-4.050 (2).

**DHSS:** 19 CSR 20-3.060 - Minimum Construction Standards for Onsite Wastewater Treatment Systems (OWTS).

14. Are there other regulations in place to prevent the degradation of aquifers?

**MGS:** 10 CSR 23-3.020, 10 CSR 23-4.050, 10 CSR 23-5.030, and 10 CSR 23-6.020.

15. What regulations are in place to set limits on constituents of injected fluids?

**WPP:** Missouri's water regulations and law include groundwater as a water of the state. Therefore, when appropriate, UIC permits provide limits on the injection of pollutants of concern to ensure pollutants of concern do not impact waters of the state, including groundwater. Chapter 644, RSMo, prohibits any person from placing any water contaminant in a location where it is reasonably certain to cause pollution. 10 CSR 20, Chapter 7 establishes groundwater quality standards. 10 CSR 20, Chapter 6 establishes permitting requirements to ensure protection and/or monitoring of groundwater, when appropriate. These requirements may be used to monitor injected fluids for potential pollutants and to require groundwater monitoring around UIC projects.

How is "when appropriate" determined?

Appropriate if any indication that injection would go past mcl., if so then would change limits. If there is an indication that a USDW would be impacted by operations, then yes.

**ERP:** For remediation injection projects, documentation (such as manufacturer research, academic papers, bench tests, and/or pilot tests) must be provided to

prove that the injectate will remediate contaminants of concern. Additionally, there must be a plan in place to either withdraw the injectate or reduce it to pre-injection levels.

**DHSS:** 19 CSR 20-3.060 - Minimum Construction Standards for OWTS.

16. How is monitoring of the injected fluid or changes to the aquifer as a result of injection operations (e.g. mobilization of metals in aquifer storage and recovery operations) regulated?

**WPP:** Missouri's water regulations and law include groundwater as a water of the state. Therefore, when appropriate, UIC permits require routine groundwater monitoring to ensure pollutants of concern do not impact waters of the state, including groundwater. Chapter 644, RSMo, prohibits any person from causing pollution to any waters of the state, which in Missouri include groundwater. 10 CSR 20, Chapter 7 establishes groundwater quality standards. 10 CSR 20, Chapter 6 establishes permitting requirements to ensure protection and/or monitoring of groundwater, when appropriate. These requirements may be used to require groundwater monitoring around UIC projects.

**ERP:** Each injection project requires a site-specific plan to monitor injection project progress. If water sources for domestic use are likely to be affected, additional requirements to monitor water quality are required for the site-specific plan.

17. Does the state allow for the "land-spreading" of solid waste generated by injection well drilling operations? If so, is this information maintained by the State and available to the public?

**WPP:** Yes, options vary based on well type, well purpose, waste materials, and land application areas. Some permitting exemptions (allowances) are established in state regulations. As these vary widely, they are reviewed and assistance provided on a case-by-case basis.

**ERP:** "Land-spreading" of solid waste generated by drilling operations is permissible, except when the solid waste would pose a risk to human health and/or the environment due to the presence of contaminants. Most remediation sites have a plan for disposal of contaminated site waste. Information about "land-spreading" is not specifically maintained by ERP or the WMP.

18. Does the State have any regulations which govern the retention by injection well owners/operators in the state of records, forms, reports and other items that are

required by a permit? If so, what is the retention period that these records must be maintained and kept on file and available upon the State's request?

**WPP:** Recordkeeping requirements are established in each permit.

What sort of record retention period is typically established as a permit condition?

Standard conditions Part 1. The standard conditions of 5 years, just states must be retained by 5 years.

19. Does the State have any notification requirements regarding injection wells being sold or transferred to another company or individual(s)? If so, are there any time limits or constraints when this must be accomplished?

Yes, permits for UIC may be transferred in accordance with 10 CSR 20-6.010(11). Applications for transfer of permits must be submitted within 30 days of the transfer of ownership or responsibility.

#### E. Class III Wells

1. While the state currently does not have any Class III injection wells, this type of well is allowable under the current EPA approved state UIC program as well as state regulations. If someone were to apply for a Class III injection well, what rules would apply and how would the request be processed?

10 CSR 20, Chapter 6 would apply unless otherwise specifically addressed elsewhere. The permit process for UIC permitting is the same as other state or NPDES permits.

#### F. Class V Wells

1. What types of Class V wells does MDNR administer?
- Onsite Waste Water Treatment Systems with Drainfield Disposal
  - Groundwater Remediation Wells
  - Mine Backfill Wells
  - Heat Pump/Air Conditioning Return Flow Wells
  - Aquifer Recharge Wells
  - Abandoned Water Wells Used for Waste Disposal

- Storm Water Drainage Wells
- Improved Sinkholes

2. How many of each type of Class V well regulated by MDNR are in the state's inventory?

Well Type	Number <sup>1</sup>
Abandoned Water Well Used For Disposal of Waste	503
Aquifer Recharge Well	10
Automobile Service Station Disposal	43
Heat Pump/Air Conditioning Return Flow	274
Improved Sinkhole	1,004
Industrial Drainage Well	73
Mine Backfill Well	162
Septic System Drainfield Disposal Method (mostly regulated by DHSS)	4,736
Septic System Well Disposal Method	11
Storm Water Drainage Well	7
Subsurface environmental remediation	3,862

<sup>1</sup>As of May 17, 2019

Please explain where these numbers came from and how they were grouped?

Will speak with Chris and will find out and communicate at a later date.

3. With the reduced resources that MDNR is receiving, will there be any priority changes regarding Class V wells?

Any change in funding will likely affect the quality of inventory and reporting.

4. Please explain what changes may occur with reduced funding.

Any change in funding will likely affect the quality of inventory and reporting.

5. Are efforts are being made to identify "high risk" wells in the current Class V inventory?

**WPP:** No. Permitted facilities are inspected and permits are regularly reviewed at renewal. If any issues are found during either process, those issues are addressed for the facility to continue to be permitted and operate.

**ERP:** There is no specific effort to identify “high risk” wells within ERP or the WMP. Injection wells for remediation sites are generally active and/or monitored, so it is unlikely that a “high risk” well would be on a remediation site.

If so, what actions or approaches (e.g., BMPs) have been taken to reduce environmental risks posed by these wells, particularly in source water areas?

N/A

6. What state agency regulates Large Capacity Septic Systems wells (i.e., lateral fields) used to inject the waste or effluent from a multiple dwelling, business establishment, community or regional business establishment septic tanks?

**WPP:** Regulates domestic facilities with flows greater than 3,000 gpd and those of any flow volume that inject industrial process wastewater. DHSS, or other local onsite permitting authority, regulates domestic facilities that have flows  $\leq 3,000$  gpd.

7. What statutory and regulatory authority does the state have/use to administer on-site sewage systems?

**WPP:** Chapter 644, RSMo, and associated regulations give WPP authority to require permits for the discharge of pollutants to waters of the state, which include groundwater.

**DHSS:** Sections 701.025-701.059, RSMo, and 19 CSR 20-3.060 - Minimum Construction Standards for OWTS, and some county health department ordinances.

8. If another state agency or program is involved or responsible for oversight of Large-Capacity Septic Systems, how frequently is this information transmitted to MDNR for purposes of updating the state’s Class V inventory and what information is included?

**MGS:** Data is collected from a database maintained by the WPP on a quarterly basis. DHSS provides permitting information on a semi-annual basis. Individual county health departments are contacted and information requested on an ad-hoc basis as staff time allows.

9. How are Aquifer Remediation wells regulated by the state and if they are permitted, what are the permit conditions placed on these operations? Also, what is the typical nature of the fluids or materials being injected into them?

**MGS:** Missouri Well Construction Rules regulate the construction of aquifer remediation wells, but not the materials being injected. The drilling contractor will submit a well construction report. MGS reviews the report for minimum construction standards.

**ERP:** For remediation projects, injection into an aquifer is permitted but there must be a plan for injection chemicals to be withdrawn or reduced to pre-injection levels. The following additional information must be collected for each hydraulically distinct zone into which injection is to occur both prior to and following injection: Biological Oxygen Demand (BOD); Chemical Oxygen Demand (COD); Total Organic Carbon (TOC); Ammonia as N; groundwater flow velocity, direction(s), and gradient(s); temperature; and pH. The typical fluids used for remediation injection projects are those that facilitate or increase biodegradation of contaminants.

10. How are Mine Backfill projects regulated by the state and if they are permitted, what are the permit conditions placed on these operations? Also, what is the typical nature of the materials being injected into them?

**WPP:** Mine stabilization projects are permitted by the WPP. The fill material must have a beneficial use authorized through WMP. Mine stabilization UIC permits include groundwater monitoring for pollutants of concern around the mine location during the mine stabilization project. As the materials used typically must solidify to be considered “beneficial” for this purpose, the permit and groundwater monitoring typically end with completion of the stabilization project, unless monitoring data analysis justifies continuation of groundwater monitoring.

**ERP:** The Waste Management Program (formerly Solid Waste Management Program) oversees the beneficial use permit exemption approvals under Section 260.205 RSMo, and 10 CSR 80-2.020. Examples of materials include certain types of fly ash used as a flowable fill.

#### G. Pressures & Confinement

1. Have there been any problems related to over-pressuring of wells or formations due to injection activities?



**ERP:** There have been two reports of over-pressuring of wells in 2010 by the Federal Facilities Section of the ERP. In both incidents, injection wells were over-pressured to the point that injection fluids pushed to the surface.

- If so, how has MDNR responded?

For the wells described above, injection was immediately stopped and additional analysis of the geologic and hydrologic conditions was conducted and is still ongoing.

2. Does MDNR determine fracture pressure for deep Class V injection wells in order to ensure that the confining zone above and below the injection formation will remain intact?

No

How does MDNR establish approved injection pressures for deep Class V injection wells?

For deep wells, would consult with MGS on injection pressures and water program would have discussion with need for pressures. Nothing deeper than 200' in last 10 years.

If so, please describe the process and include any formulas that may be used to make that determination.

N/A

#### H. Financial Assurance

1. What are the financial responsibility requirements for Class I, III & V wells in the state? Do you feel that these requirements are adequate to cover the costs associated with plugging and abandonment should the owner walk away from the well(s)?

There are no specific financial responsibility requirements for Class V wells.

If a Class III well was put into operations, what financial responsibility requirements would MDNR implement?

The permittee must show evidence of financial responsibility to the director through submission of a surety bond or equivalent. The permittee is required to maintain

financial responsibility and resources to close, plug, and abandon any operation (10 CSR 20-6.090(2)(A)15.

2. Prior to commencement of drilling or assuming operation of an injection well, does the State of Missouri or MDNR require the well owner/operator to have financial safeguards (e.g. bonds, cash, certificate of deposits, etc.) in place?

The well owner/operator is not required to have financial safeguards prior to commencement of drilling, but bonds are required by the Missouri Well Construction Rules when a contractor's permit is revoked (see section 256.616, RSMo) or if a contractor wishes to post a bond in lieu of time as required by the apprenticeship program (see 10 CSR 23-1.050). In addition, there may be some sites under the Federal Facilities Section that are required to obtain financial assurance for the performance of the remedy as a whole due to a consent decree or administrative order.

3. If yes, please explain in detail the various mechanisms that can be used by the owner/operator in order to establish financial assurance.

N/A

For each financial assurance mechanism, please indicate the following:

- How the dollar amounts are established and if there are limits on what those amounts are?
- Do you feel that these requirements are adequate to the cover plugging and abandonment costs should the owner walk away from the well(s)?
- What kind of periodic review occurs to ensure that the level of financial assurance is still adequate?
- Are abandoned/orphaned wells being plugged in a timely manner after being discovered?

4. Is the State of Missouri named as "the Payee" on all financial assurance mechanisms in the event of default or cancellation by the owner/operator?

No, for some sites under the oversight of Federal Facilities or on the National Priority List, the EPA may be named as "the Payee."

If not, which mechanisms is Missouri the payee and not? Please provide EPA an example of an instrument naming Missouri as the Payee.

The Department is the payee for mechanisms described in Section 256.616, RSMo, and 10 CSR 23-1.050. For example, a performance bond provided by a contractor who has had a permit revoked must be payable to the Department.

5. Have there been instances in Missouri since 2000 where the financial guarantees posted by the owner/operator were insufficient and state funds were required to be expended in order to accomplish well plugging?

No

I. Well Mechanical Integrity

1. Does MDNR require any Class V well type to demonstrate mechanical integrity either before allowing injection into the well or periodically thereafter?

An injection well would have to demonstrate that it functions as intended for the remediation of contaminants. Problems with an injection well would be reported and addressed by the owner/operator. If problems are not addressed, ERP and WMP would refer the site to WPP and/or MGS for enforcement.

What about non-remediation wells?

Could and or would be integrated into the permit conditions.

2. If so, what types of Class V wells is this required on and what methods are operators allowed to use to demonstrate the mechanical integrity of the well? Also, how far in advance must an operator inform the state of the planned test?

All Class V wells within the ERP and WMP are required to undergo procedures to demonstrate efficacy.

3. How soon must an injection well owner/operator notify the state of a down-hole failure, or about conditions which may endanger the subsurface environment or the public?

For any problems that arise on a remediation site, the owner/operator is required to notify the ERP and WMP project manager as soon as possible. If there is a failure of

containment, the owner/operator is required to contact the 24-hour Environmental Emergency Response Hotline immediately.

J. Public Participation and Outreach

1. For all applicable permit actions for Class V wells, are there any new or innovative approaches, which MDNR has employed to give notice of a permit action?

No, the traditional public notice procedures associated with permitting are used.

2. How does MDNR process and respond back to individuals who have submitted permit comments?

**WPP:** During a permit public comment period, the Department responds to all comments received. Each commenter will receive a response to comments. If a public meeting is held, comments received during the public meeting will also be addressed. Changes may be made and an explanation of those changes or lack thereof is provided in the comment response letter.

How does MDNR decide enough interest has been shown by the public that a public meeting should be held?

The decision to hold a public meeting is ultimately up to MDNR. Regulations in 10 CSR 20-6.020(4) states that the department shall hold a public hearing if there is significant technical merit and concern related to the responsibilities of the Missouri Clean Water Law.

**ERP:** For most remediation sites, the ERP or WMP project manager works directly with stakeholders to address any comments. This may include correspondence through letters, phone calls, emails, and/or site visits. For remediation sites that may go through a remedy process, comments are addressed as necessary.

**DHSS:** Either permits/denies the design in accordance with 19 CSR 20-3.060.

3. Does MDNR prepare and send a responsiveness summary and a final decision notice to the individuals or entities who had submitted comments?

**WPP:** Yes, during a permit public comment period, the Department responds to all comments received. Each commenter will receive a response to comments. If a

public meeting is held, comments received during the public meeting will also be addressed. Changes may be made and an explanation of those changes or lack thereof is provided in the comment response letter.

**ERP:** For most remediation sites, the ERP or WMP project manager works directly with stakeholders to address any comments. Final decision notices would be sent as requested or as needed depending on project conditions.

**DHSS:** Either permits/denies the design in accordance with 19 CSR 20-3.060.

4. How is the public notified of the final action or decision?

**WPP:** Each commenter will receive a response to comments. Site-specific permits are available on our webpage.

**ERP:** For most remediation sites, public notification may be transmitted through notices in the newspaper, direct written notices, and publication on the MDNR website.

5. On average, how long does it take MDNR to provide responses to comments received during the public participation portion of the permitting process?

Depending on the nature and number of the comments, responses are typically provided within 90 days, but can vary between 30 and 180 days.

K. Temporarily Abandoned Wells

1. Currently, are there any outstanding cases of abandoned wells still needing to be plugged after the well has been determined to be Temporarily Abandoned (TA)?

There are no outstanding cases of temporarily abandoned Class V wells.

**DHSS:** No. DHSS does not track these.

2. Are there cases where a well would be required to have an MIT conducted prior to entering TA status and if so, is the well required to undergo a periodic MIT while in TA status?

Not to our knowledge.

L. Plugging and Abandonment

1. What are the state accepted/standard methods of plugging Class V wells?

10 CSR 23-5.080 describes plugging requirements for open loop heat pump wells.

10 CSR 23-4.080 describes plugging requirements for monitoring wells.

2. If a well owner indicates to the state that they plan on plugging a Class V injection well, what response is given by the state to the request and if there is a time limit by which either the well owner must submit the request in advance of the planned plugging or by which the state must respond to the request?

**WPP:** Certain Class V wells WPP permits contain conditions requiring the submission of a closure (plugging) plan for the well upon the cessation of activities. These plans are reviewed and approved by regional office staff before closure/plugging may commence. Once completed the permit is terminated by program staff.

What types of Class V wells typically require a closure plan?

Standard conditions part 1, site specifics require closure plans to no longer be out of permit requirements.

**ERP:** For injection projects within the ERP and WMP, all remediation work is required to be approved prior to beginning work. The time frame and response is variable depending on section and applicable remediation regulations. All wells are required to comply with the Water Well Driller's Act.

3. What post closure monitoring is required after a well is plugged?

**WPP:** Usually no post-closure monitoring.

**ERP:** Within ERP and WMP, post-closure monitoring requirements are determined by site and project-specific conditions.

All wells are required to comply with well plugging standards pursuant to 10 CSR 23 and Sections 256.600-256.640, RSMo.

4. Are abandoned/orphaned wells being plugged in a timely manner after being discovered?

Wells that are regulated by Sections 256.600-256.640, RSMo, are required to be plugged when they have not been in use for 2 years or more and are in a state of disrepair.

Are there currently any wells that have not been in use longer than 2 years or in a state of disrepair which still require plugging?

There probably are some, however MDNR is currently unaware of any but if any wells were found they would be addressed.

#### M. Compliance and Inspections

1. What field activities related to the Class V UIC program are conducted to ensure compliance?

**WPP:** Regional office staff conduct periodic compliance inspections to determine compliance with Missouri State Operating Permits issued for the activity.

**ERP:** Site visits or site inspections are conducted periodically or as needed depending on the project-specific needs and staff resources within the ERP and WMP. Site visits or site inspections for an ERP and/or WMP remediation project may include observation of well installation, well sampling, well testing, well location, injection events, and well closure.

**DHSS:** Does not conduct any such field activities other than activities associated with the permitting process.

2. Have these field activities also included outreach and education efforts aimed at the regulated community to ensure compliance with program requirements?

**WPP:** Regional office staff also provide Compliance Assistance Visits and/or Technical Assistance Visits that are aimed at assisting the regulated community in complying with terms and conditions of a permit and demonstrating how to operate a facility or conduct an activity in such a way as to maximize efficiency and guarantee compliance. WPP often consults with MGS on technical aspects associated with Class V well operations and compliance with the UIC program. In a sense, WPP acts as a facilitator between the regulated UIC entity and MGS.

**ERP:** Site visits or site inspections for the ERP or WMP may include a component of educating stakeholders (compliance assistance). Additionally, the ERP or WMP may hold community outreach events or stakeholder meetings for specific injection projects.

3. Is there ever sampling and analysis which has been conducted in conjunction with those field activities?

**WPP:** Where appropriate, regional office staff will collect samples to determine compliance with sampling requirements listed in Missouri State Operating Permits. Perimeter testing on piezometers or boreholes may occur in certain scenarios to evaluate migration of fluid.

**ERP:** Site visits or site inspections for an ERP and/or WMP remediation project may include soil, soil vapor, or groundwater sample collection from monitoring wells.

4. Is there a QA/QC plan for UIC program field activities and/or sampling and if so, where is a copy of plan(s) maintained?

There is no specific quality assurance or quality control plan for the UIC program. MDNR operates under its Quality Management Plan (QMP) when collecting or overseeing the collection of environmental sampling data. This plan requires that any subgrantees, contractors, or, in some cases, the regulated community, who generate environmental data develop Quality Assurance Project Plans (QAPPs) or other appropriate quality management tools. The QMP covers all intramural and extramural monitoring and measurement activities that generate and process environmental data for use by the Department. QAPPs can be site or section-specific.

5. How frequently is the QA/QC plan reviewed to determine if it needs to be updated?

Quality Assurance Project Plans (QAPPs) for ERP and WMP are updated at least every five years.

6. What is the scope of a Class V well inspection?

**WPP:** Regional office staff conduct periodic compliance inspections to determine compliance with Missouri State Operating Permits issued for the activity. The scope would be compliance with the permit. WPP regional office staff are not equipped to



evaluate components of the UIC program implementation outside of what is contained in the permit.

What particular components of the UIC program are the regional office staff not equipped to evaluate or wouldn't be addressed in the permit?

Within the WPP primary experience is through NPDES. Any permits that would go into UIC details or any inspections relating to MIT or other deeper well components would be consulted with MGS.

**ERP:** Neither ERP nor WMP conduct Class V well inspections. A project manager within the ERP and/or the WMP may conduct a site visit or site inspection during which the manager may observe the installation, testing, sampling, or closure of an injection well.

7. What does the inspector look at during a Class V well inspections?

**WPP:** Regional office staff would look at those areas of the site or operation that relate to the permit conditions.

**ERP:** Site visits or site inspections within the ERP and WMP are made to verify characterization and remediation work and to provide on-site technical and regulatory guidance. However, project managers may observe on-site conditions that may pose a danger to human health or the environment.

What type of inspections are conducted by the ERP? Question 6 above mentions that no Class V well inspections are conducted, but question 7 mentions that they may be. Please clarify.

Primarily only visual inspections are conducted.

8. How many field inspections on Class V wells has so far conducted this year?

**MGS:** 530 wells were inspected as of May 17, 2019, for Federal Fiscal Year 2019.

**ERP:** Has conducted 6 site visits or site inspections for sites with injection wells for Federal Fiscal Year 2019. These sites have a total of 630 injection wells, points, and trenches. The WMP has not conducted any site visits or site inspections at injection projects this Federal Fiscal Year.

9. What criteria does the State follow for determining which wells receive field inspections?

**WPP:** WPP is required to conduct a minimum number of inspections on NPDES facilities in order to maintain primacy of the NPDES program and federal and state funding. Therefore, NPDES inspections take priority in inspection planning. As time allows, UIC permitted facilities will be inspected; however, to the best of our knowledge, WPP does not receive any funding other than permit fees to implement the UIC program.

**ERP:** Site visits and site inspections for the ERP and WMP are determined by injection site conditions and project needs.

10. Were there any Class V well inspections, violations and/or enforcement actions to report on federal facilities this fiscal year? In the last 5 fiscal years?

**MGS:** A query of the UIC Application shows that there were 472 Class V well inspections at federal facilities this Federal Fiscal Year. There were 473 inspections, one violation, and one enforcement action at federal facilities in the last five fiscal years. The enforcement action was a Letter of Warning for a Delinquent Permit Fee.

**ERP:** The Environmental Remediation Program and Waste Management Program refers compliance issues with injection wells to the Water Protection Program for enforcement.

Annual Site Visits/Inspections for Federal Facilities within the Environmental Remediation Program				
Year	Number of Site Visits/Inspections conducted	Number of Sites visited/inspected	Number of Wells at Visited/Inspected Sites	Number of Injection Wells Inspected
October 1, 2018 - March 31, 2019	4	2	244	488
October 1, 2017 - September 30, 2018	19	8	423	711
October 1, 2016 - September 30, 2017	12	6	264	578
October 1, 2015 - September 30, 2016	15	7	376	382

October 1, 2014 - September 30, 2015	14	5	349	894
October 1, 2013 - September 30, 2014	3	4	35	893

#### N. Enforcement

1. Please explain the enforcement process that the state undertakes from the time UIC program violation is discovered until resolution is achieved.

**MGS:** Violations of the Missouri Well Construction Rules are handled through enforcement actions such as Letters of Warning, Notices of Violation, Administrative Orders, and Penalty Demand Letters.

**WPP:** Initial response is at the regional level with Letters of Warning (LOWs) and Notices of Violation (NOVs). Region staff outline actions that will resolve the violations and will provide technical and compliance assistance as requested. If these efforts do not resolve the violations, the matter will be escalated by referral to the Department's Compliance and Enforcement Section for formal enforcement action. WPP must demonstrate that the violations represent significant non-compliance prior to taking formal enforcement action against an entity. Once formal enforcement action is warranted, Compliance and Enforcement staff complete the following: 1) a settlement offer along with a consent order requiring specific corrective actions addressing the violation(s); 2) negotiations; 3) settlement and implementation of agreed-upon actions; and 4) completion of corrective actions including payment of penalty. In rare cases, the Department issues unilateral orders to address violations. Negotiations do not occur within the unilateral order enforcement process. If Compliance and Enforcement staff efforts do not resolve the violations, staff refer the case to the State Attorney General's Office for resolution.

**DHSS:** Notice of Violation is issued and sent to the local prosecuting attorney if nuisance is not abated within approximately 30-60 days.

2. What are the most common types of Class V injection well related violations that are subject to a Notice of violation (NOV) and follow-up enforcement action by MDNR?

**MGS:** There have not been any recent enforcement actions related to Class V injection wells. A well regulated by Sections 256.600-256.640, RSMo, that has not

been in use for a period of 2 years or more and is in a state of disrepair may result in enforcement actions.

**WPP:** There have not been any recent enforcement actions related to Class V injection wells. Likely Class V injection well related violations involve large capacity soil absorption systems servicing multiple residents of 20 or more people that have domestic wastewater treatment design capacities of 3,000 gpd or more. Likely violations include failing to submit reports as required by the permit, failing to renew the permit, discharging without a permit, or operating without a permit.

**DHSS:** Surfacing effluent.

#### What is MDNR's process for elevating an enforcement action?

**MGS:** Enforcement actions such as LOWs, NOVs, and administrative orders to plug a well are issued by the Department. An administrative order may be referred to the Attorney General's Office.

**WPP:** Significant effort is made by the Department to return the responsible party to compliance prior to escalation. Region staff issue LOWs and NOVs identifying violations and actions that will resolve the violations. Region staff also provide technical and compliance assistance to permittees on request. If these actions do not resolve the violations, region staff prepare documentation referring the case to the Compliance and Enforcement Section at the Department's Central Office. In rare cases, if Compliance and Enforcement staff are not able to resolve the violations with an Administrative Consent Order, the Department may issue unilateral orders to address violation(s). If Compliance and Enforcement staff efforts do not resolve the violations, staff refer the case to the State Attorney General's Office for resolution.

**DHSS:** Local prosecuting attorney.

#### 3. What guidelines does MDNR use to determine what is a Significant Non-Compliance?

**WPP:** Utilizes the significant non-compliance (SNC) definition associated with the UIC program. However, WPP consults with MGS on evaluation of the UIC operation against that SNC definition. WPP does not have the technical expertise (no geologist or well engineers) to conduct the SNC evaluation. As a rule of thumb, the SNC associated with the NPDES program will be used for reporting requirements associated with a permit issued by the program. Although UIC is not NPDES, and is not subject to NPDES rules, WPP issues UIC permits with terms and conditions in a manner similar to an NPDES permit. These terms and conditions require monitoring

and reporting by the permittee. If the permittee fails to conduct the monitoring or submit the reports, WPP takes necessary levels of compliance and enforcement actions to compel compliance. This falls outside the UIC program definition of SNC, but aligns with the NPDES definition of SNC.

**DHSS:** Any type of nuisance defined by Section 701.025(7), RSMo.

4. How many and what, if any, ongoing Class V well related enforcement actions are being handled through the Attorney General's office?

**MGS:** None.

**WPP:** Estimate of Class V well enforcement actions currently being handled by the Attorney General's office is 1. The case is against Mr. Larry Owens, former owner of Casa de Loco Winery. Mr. Owens was operating without a permit and causing pollution to waters of the state. The state is seeking penalties from Mr. Owens for the past violations of the Missouri Clean Water Law (MCWL). The new owner has now achieved compliance with MCWL.

**ERP:** ERP and WMP refer all compliance issues with injection wells to the WPP for enforcement.

If there are none, what situations would prompt such an action?

N/A

5. Provide the EPA review team with examples of administrative orders, consent agreements and civil/criminal referrals that have been issued to Class V well facilities during 2016-2018 or the most recent examples of these actions.

**WPP:** In 2017, the Department issued a Unilateral Order (Administrative Order with penalty) to Casa de Loco Winery - <https://dnr.mo.gov/env/wpp/enf/2017-AOC/docs/casadeloco.pdf>. Prior to 2016, the Department issued an Abatement Order on Consent to Geary Mobile Home Park in 2015 - <https://dnr.mo.gov/env/wpp/enf/2015-AOC/docs/GearyMobileHomePark.pdf>.

**ERP:** All compliance issues with injection wells are referred to WPP for enforcement.

O. Electronic Data Systems